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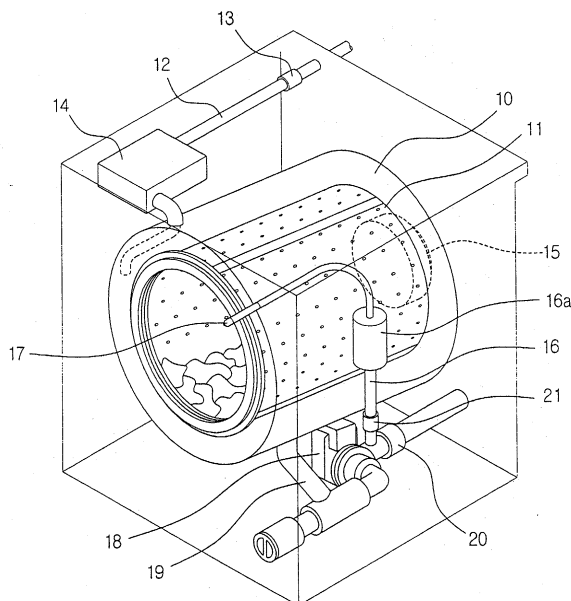
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(54) **Washing machine**

(57) A drum washing machine including a water tub, a rotary tub rotatably provided in the water tub, a detergent feed pipe having a first end connected to the water tub and a second end disposed at an inlet of the rotary tub, and a detergent feed unit to feed a detergent contained in the water tub into the rotary tub through the detergent feed pipe, wherein the detergent feed unit dissolves the detergent before feeding the detergent into the rotary tub in response to the detergent being a powdered detergent.

FIG. 1



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Description

[0001] The present invention relates to a drum washing machine comprising a fixed water tub containing a rotatably mounted rotary tub to receive laundry to be washed, a control unit and a detergent feed unit through which water and detergent supplied to the fixed water tub is circulated into the rotary tub, and to a method of controlling the drum washing machine.

[0002] A conventional drum washing machine executes a washing process by supplying a detergent and a set amount of water together into a water tub, dissolving the detergent in the water solely by an alternating directional rotation of a rotary tub, and allowing the dissolved detergent to soak through laundry. Therefore, the same washing process is performed regardless of the type of detergent used, for example, whether powdered detergent or liquid detergent is used.

[0003] In the conventional drum washing machine, the detergent that is supplied into the water tub sinks to a bottom of the water tub, and is dissolved in the water while the rotary tub is rotated in opposite directions. However, a liquid detergent generally dissolves more readily than a powdered detergent and so the relatively long time taken for powdered detergent to dissolve increases the length of the washing cycle time. Furthermore, the powdered detergent may not completely dissolve in the water solely through the opposite directional rotation of the rotary tub, even with a longer washing time, and therefore, detergent deposits may remain which decreases washing performance.

[0004] Another aspect of conventional drum washing machines is that the detergent solution, be it made from powdered or liquid detergent, is caused to gradually soak through the laundry from an outer part to a centre part thereof, solely by the opposite directional rotation of the rotary tub. Therefore, it may take a relatively long time for the detergent solution to soak through from the laundry in contact with the lower part of the inner wall of the rotary tub to the laundry at the centre. In certain circumstances, the detergent solution may even not sufficiently soak through to the centre part of the laundry at all. Consequently, the conventional drum washing machine is problematic in that the washing cycle time can be relatively long and washing performance can be poor.

[0005] Therefore, it is an aspect of the present invention to provide a drum washing machine and a method of controlling the drum washing machine that substantially alleviates or overcomes the problems mentioned above.

[0006] The drum washing machine of the present invention is characterised in that the detergent feed unit is operable to selectively perform a detergent dissolution operation in dependence on the type of detergent which is input to the control unit by a user.

[0007] In a preferred embodiment, the control unit is operable for a user to define whether the detergent is in

powder form or liquid form

[0008] The detergent feed unit preferably comprises a feed pipe connecting the fixed water tub at a first end to an inlet to the rotary tub at a second end and a pump for pumping water and detergent through the feed pipe.

[0009] A dissolution member is conveniently disposed between said first and second ends of the feed pipe defining a dissolution space formed by an enlarged diameter section of the feed pipe. Advantageously, the detergent dissolution operation comprises switching the pump on and off to cause water and detergent to reciprocate between the fixed water tub and the detergent dissolution space.

[0010] The drum washing machine may further include a spray nozzle provided at the second end of the detergent feed pipe.

[0011] The control unit may drive the pump to feed the dissolved powdered detergent into the rotary tub.

[0012] The drum washing machine may further include a key input unit having a powdered detergent button and a liquid detergent button, the control unit determining whether the detergent contained in a lower portion of the water tub is powdered detergent according to whether the powdered detergent button is selected on the key input unit.

[0013] Preferably, the control unit drives the pump to clean the detergent feed pipe if the detergent contained in the water tub is determined as being powdered detergent.

[0014] A method of the present invention is characterised by the step of inputting a type of detergent being used into the control unit to selectively perform a detergent dissolution operation in dependence on the type of detergent selected.

[0015] Preferably, the method includes the step of a user selecting the detergent type by means of buttons on a control unit.

[0016] Conveniently, the step of determining the type of detergent used comprises determining whether the detergent is in powder form or liquid form and preferably the detergent dissolution operation is only performed if the determined detergent type is powdered form.

[0017] In a preferred embodiment, the washing machine comprises a detergent feed pipe connected to the fixed water tub and leading to an inlet of the rotary tub, and a pump disposed in the detergent feed pipe, and the step of performing the detergent dissolution operation comprises the step of operating the pump to repeatedly reciprocate water and the detergent between the fixed water tub and the detergent pipe.

[0018] The detergent pipe advantageously includes a dissolution member defining a dissolution space formed by an enlarged diameter section of the detergent feed pipe, and the step of repeatedly reciprocating the water and detergent between the fixed water tub and the detergent pipe preferably comprises the step of reciprocating the water and detergent between the fixed water tub and the dissolution space. The method preferably in-

cludes the step of rotating the rotary tub at the same time as the step of performing the detergent dissolution operation.

[0019] The drum washing machine control method may further include the step of driving the pump to clean the detergent feed pipe after dissolving and feeding the powdered detergent.

[0020] A preferred embodiment of the present invention will now be described, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view showing an internal structure of a drum washing machine according to an embodiment of the present invention;

Figure 2 is a control block diagram of the drum washing machine of Figure 1; and

Figure 3 is a control flowchart of a method of controlling the drum washing machine according to an embodiment of the present invention such as shown in Figure 1.

[0021] Referring now to Figure 1, the drum washing machine of the present invention includes a water tub 10, and a rotary tub 11 which is rotatably mounted within the water tub 10. A water feed pipe 12 connects an external water supply pipe to the water tub 10 to enable wash water to be supplied thereto and a water feed valve 13 is mounted in the water feed pipe 12 to control the flow of water.

[0022] A detergent container 14 capable of receiving a powdered detergent or liquid detergent is mounted in the water feed pipe 12 between the water feed valve 13 and the water tub 10. Therefore, wash water flowing through the water feed pipe 12 runs over the detergent contained in the detergent container 14 so that the detergent is fed into the water tub 10 together with the wash water.

[0023] A reversible motor 15 is connected to the rotary tub 11 and is operable to rotate the rotary tub 11 in a single direction or in opposite directions.

[0024] A detergent feed pipe 16 is provided having a first end connected to the water tub 10 and a second end extending outside of the water tub 10 to an inlet of the rotary tub 11. A cylindrical detergent dissolution space 16a, having a diameter greater than that of the detergent feed pipe 16 is mounted at a centre portion of the detergent feed pipe 16 to temporarily store a detergent solution. A spray nozzle 17 is mounted at the second end of the detergent feed pipe 16 to enable the detergent solution to be sprayed into the rotary tub 11.

[0025] The drum washing machine of the present invention is provided with a detergent feed unit that is operable to dissolve a powdered detergent and then feed the dissolved detergent into the rotary tub 11. The detergent feed unit is also operable to feed a liquid detergent dissolved in water into the rotary tub 11. The detergent feed unit includes a pump 18 provided in the detergent feed pipe 16.

[0026] A process of dissolving a powdered detergent and feeding the detergent solution using the pump 18 will now be described. If the detergent contained in the water tub 10 is powdered detergent, the pump 18 is repeatedly turned on and off to reciprocate the powdered detergent and water between the lower portion of the water tub 10 and the detergent feed pipe 16. The action of the agitation and mixing of the powdered detergent in the water thereby causes the detergent to quickly dissolve in the water. The pump 18 is then turned on to feed the dissolved detergent into the rotary tub 11 through the detergent feed pipe 16 and spray nozzle 17. As a result, the dissolved detergent fed into the rotary tub 11 rapidly and uniformly soaks through the laundry regardless of materials of the laundry, thereby increasing the utilization efficiency of the powdered detergent.

[0027] A process of feeding a liquid detergent using the pump 18 will now be described. If the detergent contained in the water tub 10 is a liquid detergent, the pump 18 is turned on to feed it into the rotary tub 11 through the detergent feed pipe 16 and spray nozzle 17. The liquid detergent is directly sprayed on the centre part of laundry and it rapidly and uniformly soaks through the laundry thereby increasing the utilization efficiency of the liquid detergent.

[0028] It will be noted that for the liquid detergent operation, the detergent dissolving process performed for the powdered detergent operation is not executed. This is due to the fact that the solubility of the liquid detergent is relatively higher than that of the powdered detergent and so a separate detergent dissolving process using the pump 18 is not necessary. Furthermore, if the detergent dissolving process using the pump 18 is executed with liquid detergent, bubbles may be generated which is detrimental to the washing performance.

[0029] The detergent feed pipe 16 may be branched off from a drain pipe 19 that drains waste water from the water tub 10 to a drain outlet. In this case, the pump 18 and a drain valve 20 are mounted in the drain pipe 19 and the pump 18 may also function as a drain pump. Furthermore, a backward flow prevention valve 21 is mounted in the detergent feed pipe 16 to prevent wash water from flowing therethrough and into the water tub 10 when draining.

[0030] Referring now to the control block diagram of Figure 2, the drum washing machine includes a control unit 30 that controls the entire operation of the drum washing machine.

[0031] An input terminal of the control unit 30 is electrically connected to a key input unit 31 having washing course buttons 31a, 31b that correspond to the type of detergent being used. For example, button 31a corresponds to a powdered detergent washing course and button 31b corresponds to a liquid detergent washing course. The input terminal of the control unit 30 is also electrically connected to a water level sensor 32 that detects the level of water within the rotary tub 11.

[0032] An output terminal of the control unit 30 is elec-

trically connected to a water feed valve driving unit 33 to drive the water feed valve 13, a motor driving unit 34 to drive the motor 15, a pump driving unit 35 to drive the pump 18, a drain valve driving unit 36 to drive the drain valve 20, and a backward flow prevention valve driving unit 37 to drive the backward flow prevention valve 21.

[0033] The control unit 30 detects whether a powdered detergent or liquid detergent is to be used depending on which washing course button 31a, 31b a user has selected on the key input unit 31. If the detergent is a powdered detergent, the control unit 30 drives the pump 18 to dissolve the powdered detergent contained in the water tub 10 as described above, and then sprays the dissolved detergent into the rotary tub 11. On the other hand, if the detergent is a liquid detergent, the control unit 30 drives the pump 18 to spray and feed the liquid detergent contained in the water tub 10 into the rotary tub 11.

[0034] In the case of a powder detergent operation, after dissolving the powdered detergent and then feeding the dissolved detergent into the rotary tub 11, the control unit 30 drives the pump 18 to clean the detergent feed pipe 16 during washing.

[0035] Referring now to the control method flowchart of Figure 3, a washing course according to the type of detergent used is selected by a user in operation 100.

[0036] The control unit 30 then determines whether the selected washing course is a powdered detergent washing course or a liquid detergent washing course in operation 101.

[0037] If the selected washing course is the powdered detergent washing course, in operation 102, the control unit 30 opens the water feed valve 13 for a certain period of time to allow a predetermined amount of wash water to flow into the water tub 10 while running over the detergent container 14, thus feeding a powdered detergent from within the detergent container 14 into the water tub 10.

[0038] Then, in operation 103, the control unit 30 turns on the pump 18 to move the powdered detergent, which has sunk to the bottom of the water tub 10 to the detergent dissolution space 16a formed in the detergent feed pipe 16.

[0039] Operation 104 is then performed in which the control unit 30 opens the water feed valve 13 again to feed a set amount of water into the water tub 10. The control unit 30 then rotates the motor 15 in forward and reverse directions, to rotate the rotary tub 11 in opposite directions in operation 105. Accordingly, the laundry contained in the rotary tub 11 is soaked with the water.

[0040] While rotating the rotary tub 11 in opposite directions in operation 105, the control unit 30 repeatedly turns the pump 18 on and off so that the powdered detergent solution which is temporarily stored in the detergent dissolution space 16a flows repeatedly back into the water tub 10 and is pumped again back into the detergent dissolution space 16a. This reciprocating action quickly dissolves the powdered detergent in the water

and is performed in operation 106.

[0041] After dissolving the powdered detergent in operation 106, the control unit 30 operates the pump 18 continuously for a preset period, thus spraying the detergent solution held in the detergent dissolution space 16a into the rotary tub 11, in operation 107.

[0042] Therefore, the detergent dissolving procedure of operation 106 causes the powdered detergent to be completely dissolved in the water in a short space of time. Furthermore, through the detergent spraying procedure of operation 107, the dissolved detergent is sprayed into the rotary tub 11 to directly soak through a centre part of the laundry, thus greatly improving the utilization efficiency of the powdered detergent. Consequently, a washing time may be shortened and washing performance may be improved.

[0043] After spraying the dissolved detergent into the rotary tub 11 in operation 107, the control unit 30 pumps the water contained in the water tub 10 to the detergent feed pipe 16 by repeatedly turning on the pump 18 a certain number of times in operation 108, thus cleaning the detergent feed pipe 16.

[0044] After completing the cleaning of the detergent feed pipe 16 in operation 108, the control unit 30 executes preset washing, rinsing and drying processes in operations 120, 121 and 122, respectively, and then ends the washing course.

[0045] In an alternative process, if the washing course selected in operation 101 is not a powdered detergent washing course, in operation 110, the control unit 30 determines whether the selected washing course is a liquid detergent washing course.

[0046] If the liquid detergent washing course is selected in operation 110, the control unit 30 opens the water feed valve 13 for a certain period of time to allow a predetermined amount of wash water to flow into the water tub 10 thereby running over the detergent container 14 and feeding the liquid detergent therein into the water tub 10 in operation 111.

[0047] After feeding the liquid detergent in operation 111, the control unit 30 turns on the pump 18 in operation 112 to move the liquid detergent that has sunk to the bottom of the water tub 10, to the detergent dissolution space 16a formed in the detergent feed pipe 16.

[0048] Then, in operation 113, the control unit 30 opens the water feed valve 13 again to feed a set amount of water into the water tub 10. While feeding the set amount of water, the control unit 30 rotates the motor 15 in forward and reverse directions to rotate the rotary tub 11 in opposite directions, in operation 114.

[0049] After rotating the rotary tub 11 in opposite directions in operation 115, the control unit 30 operates the pump 18 continuously for a preset period thereby spraying and feeding the liquid detergent that is temporarily stored in the detergent dissolution space 16a into the rotary tub 11 in operation 115. The liquid detergent is thereby sprayed into the rotary tub 11 to directly soak through the centre part of the laundry, thus greatly im-

proving the utilization efficiency of the liquid detergent. Consequently, a washing time may be shortened and washing performance may be improved.

[0050] After completing the detergent spraying and feeding procedure in operation 115, the control unit 30 executes preset washing, rinsing and drying processes in operations 120, 121 and 122, respectively, and then ends the washing course.

[0051] As is apparent from the above description, the present invention provides a drum washing machine and a method of controlling the drum washing machine, which controls washing courses to correspond with selected types of detergents so as to improve the solubility and utilization efficiency of the detergents. Consequently, the present invention is advantageous in that it improves washing performance while decreasing a washing time.

[0052] Although an embodiment of the present invention has been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles of the invention, the scope of which is defined in the claims and their equivalents hereafter.

Claims

1. A washing machine comprising a fixed water tub containing a rotatably mounted rotary tub to receive laundry to be washed, a control unit and a detergent feed unit through which water and detergent supplied to the fixed water tub is circulated into the rotary tub **characterised in that** the detergent feed unit is operable to selectively perform a detergent dissolution operation in dependence on the type of detergent which is input to the control unit by a user.
2. A washing machine according to claim 1 wherein the control unit is operable for a user to define whether the detergent is in powder form or liquid form
3. A washing machine according to claim 1 or claim 2 wherein the detergent feed unit comprises a feed pipe connecting the fixed water tub at a first end to an inlet to the rotary tub at a second end and a pump for pumping water and detergent through the feed pipe.
4. A washing machine according to claim 3 comprising a dissolution member between said first and second ends of the feed pipe defining a dissolution space formed by an enlarged diameter section of the pipe.
5. A washing machine according to claim 4 wherein the detergent dissolution operation comprises switching the pump on and off to cause water and detergent to reciprocate between the fixed water tub and the detergent dissolution space.
6. A method of controlling a washing machine comprising a fixed water tub containing a rotatably mounted rotary tub to receive laundry to be washed, a control unit and a detergent feed unit through which water and detergent supplied to the fixed water tub is circulated into the rotary tub, **characterised by** the step of inputting a type of detergent being used into the control unit to selectively perform a detergent dissolution operation in dependence on the type of detergent selected.
7. A method according to claim 6 including the step of a user selecting the detergent type by means of buttons on a control unit.
8. A method according to claim 6 or claim 7 wherein the step of determining the type of detergent used comprises determining whether the detergent is in powder form or liquid form.
9. A method according to claim 8 wherein the detergent dissolution operation is only performed if the determined detergent type is powdered form.
10. A method according to any of claims 6 to 9 in which the washing machine comprises a detergent feed pipe connected to the fixed water tub and leading to an inlet of the rotary tub and a pump disposed in the detergent feed pipe and wherein the step of performing the detergent dissolution operation comprises the step of operating the pump to repeatedly reciprocate water and the detergent between the fixed water tub and the detergent pipe.
11. A method according to claim 10 wherein the detergent pipe includes a dissolution member defining a dissolution space formed by an enlarged section of the pipe, and the step of repeatedly reciprocating the water and detergent between the fixed water tub and the detergent pipe comprises the step of reciprocating the water and detergent between the fixed water tub and the dissolution space.
12. A method according to any of claims 6 to 11 including the step of rotating the rotary tub at the same time as the step of performing the detergent dissolution operation.
13. A drum washing machine comprising a water tub, a rotary tub rotatably provided in the water tub, a detergent feed pipe having a first end connected to the water tub and a second end disposed at an inlet of the rotary tub and a detergent feed unit to feed a detergent contained in the water tub into the rotary tub through the detergent feed pipe wherein the detergent feed unit dissolves the detergent before

feeding the detergent into the rotary tub in response to the detergent being a powdered detergent.

14. The drum washing machine according to claim 13 wherein the detergent feed unit comprises a pump provided at the detergent feed pipe. 5
15. The drum washing machine according to claim 13 further comprising a spray nozzle provided at the second end of the detergent feed pipe to spray the detergent into the rotary tub. 10
16. The drum washing machine according to claim 13 further comprising a detergent dissolution space formed at the detergent feed pipe to temporarily store the detergent. 15
17. The drum washing machine according to claim 14 wherein the detergent feed unit comprises a control unit to drive the pump to dissolve the powdered detergent and then feed the dissolved powdered detergent into the rotary tub. 20
18. The drum washing machine according to claim 17 further comprising a detergent dissolution spaced formed at the detergent feed pipe to temporarily store the detergent and a water feed valve wherein the control unit opens the water feed valve to feed a set amount of water into the water tub after the powdered detergent is moved into the detergent dissolution space. 25 30
19. The drum washing machine according to claim 18 further comprising a motor to rotate the rotary tub in opposite directions wherein the control unit controls the motor to rotate the rotary tub after feeding the set amount of water into the water tub. 35
20. The drum washing machine according to claim 19 wherein the control unit repeatedly turns the pump on and off to move the powdered detergent back and forth from the water tub to the detergent dissolution space to dissolve the powdered detergent. 40
21. The drum washing machine according to claim 17 wherein the control unit drives the pump to reciprocate the detergent contained in the water tub between an inside of the water tub and the detergent feed pipe to dissolve the powdered detergent. 45 50
22. The drum washing machine according to claim 17 further comprising a key input unit having a powdered detergent button, the control unit determining whether the detergent contained in a lower portion of the water tub is the powdered detergent according to the powdered detergent button being selected in the key input unit. 55
23. The drum washing machine according to claim 22 wherein the key input unit further comprises a liquid detergent button by which the control unit determines the detergent contained in the lower portion of the water tub is a liquid detergent.
24. The drum washing machine according to claim 17 wherein the control unit drives the pump to clean the detergent feed pipe in response to the detergent contained in the water tub being the powdered detergent.
25. A method of controlling a drum washing machine, the drum washing machine having a detergent feed pipe provided with a first end connected to a water tub and a second end disposed at an inlet of a rotary tub, the control method comprising feeding a liquid detergent into the rotary tub from the water tub through the detergent feed pipe in response to a detergent contained in the water tub being the liquid detergent and dissolving a powdered detergent before feeding the dissolved detergent into the rotary tub from the water tub through the detergent feed pipe in response to the detergent contained in the water tub being the powdered detergent.
26. The drum washing machine control method according to claim 25 further comprising determining whether the detergent contained in the water tub is the powdered detergent or the liquid detergent according to a powdered detergent button or a liquid detergent button selected by a user.
27. The drum washing machine control method according to claim 25 wherein the dissolving and feeding of the powdered detergent and the feeding of the liquid detergent comprise driving a pump provided at the detergent feed pipe.
28. The drum washing machine control method according to claim 27 wherein the dissolving of the powdered detergent comprises reciprocating the powdered detergent contained in the water tub between an inside of the water tub and the detergent feed pipe.
29. The drum washing machine control method according to claim 28 further comprising driving the pump to clean the detergent feed pipe after dissolving and feeding the powdered detergent.
30. The drum washing machine control method according to claim 28 further comprising rotating the rotary drum during the dissolving of the powdered detergent.
31. A drum washing machine comprising a water tub, a rotary tub provided in the water tub and a detergent

feed unit to feed a detergent contained in the water tub into the rotary tub wherein the detergent feed unit dissolves the detergent before feeding the detergent into the rotary tub in response to the detergent being a powdered detergent.

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32. The drum washing machine according to claim 31 wherein the detergent feed unit feeds the detergent contained in the water tub to the rotary tub without dissolving the detergent in response to the detergent being a liquid detergent. 10
33. The drum washing machine according to claim 31 further comprising a pump to reciprocate the powdered detergent in and out of the water tub to dissolve the powdered detergent. 15
34. A method of controlling a drum washing machine comprising feeding a detergent contained in a water tub into a rotary tub through a detergent feed pipe and dissolving the detergent before the feeding into the rotary tub in response to the detergent being a powdered detergent. 20
35. A drum washing machine comprising a water tub, a rotary tub and a spraying unit wherein a powdered detergent contained in the water tub is dissolved and then sprayed into the rotary tub by the spraying unit to soak a centre of a laundry load. 25
36. A drum washing machine comprising a water tub, a rotary tub provided in the water tub and a detergent feed unit wherein a first type of detergent is dissolved in the detergent feed unit before being fed from the water tub to the rotary tub and a second type of detergent is fed from the water tub to the rotary tub without being dissolved in the detergent feed unit. 30 35

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FIG. 1

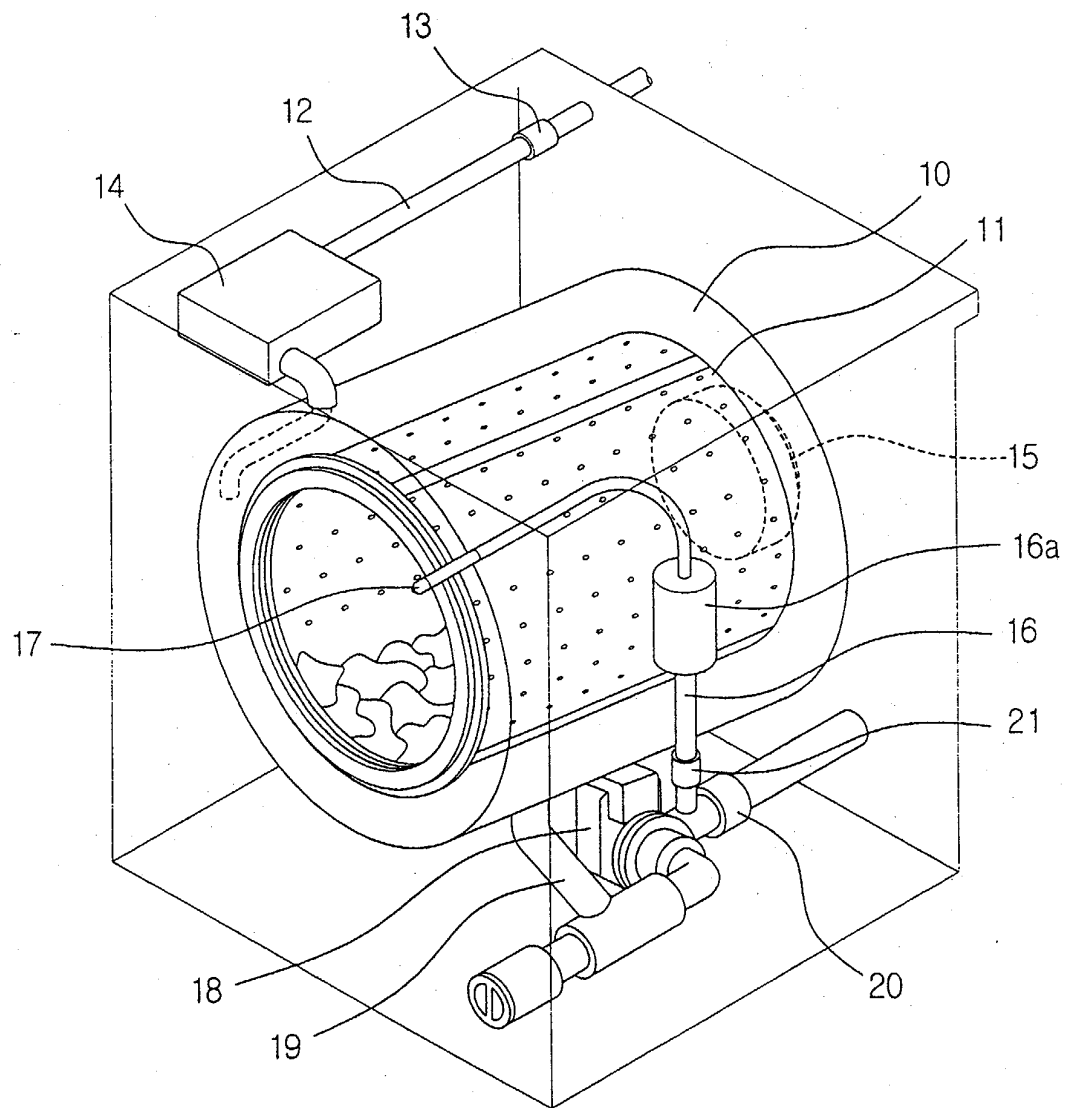


FIG. 2

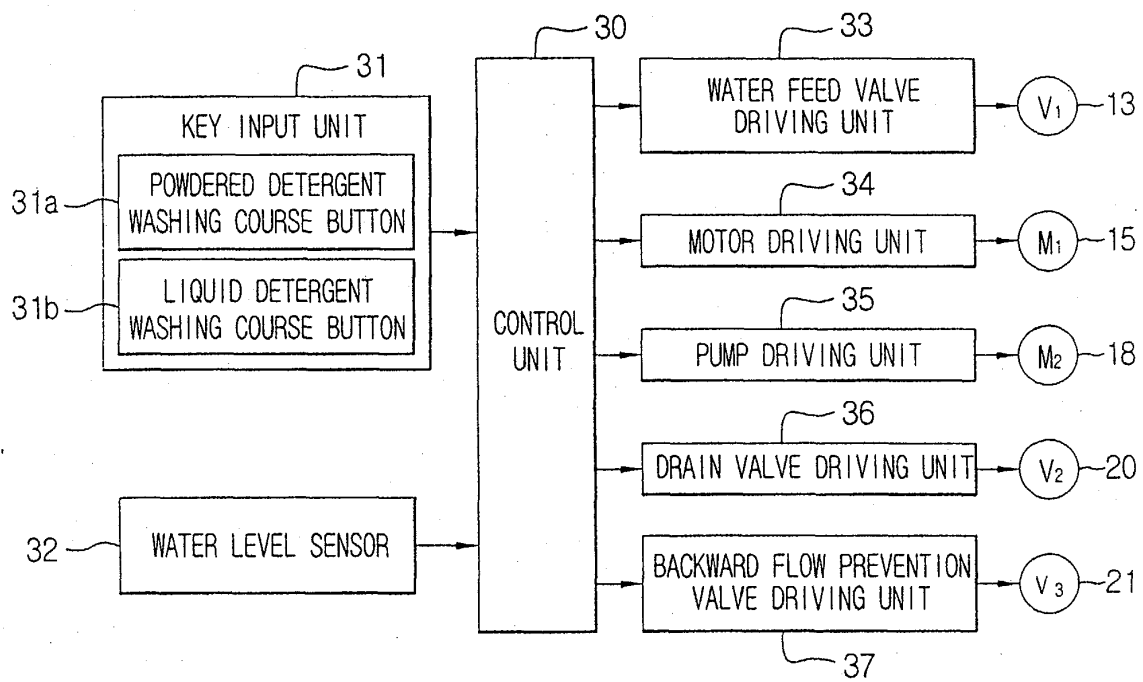


FIG. 3

